

# IMPACT OF BOAT ANCHORING ON THE MEDITERRANEAN ENDEMIC BIVALVE *PINNA NOBILIS*: AN EXPERIMENTAL APPROACH

C. Morell Luján-Williams<sup>1</sup>, G. Banach-Esteve<sup>1</sup>, M. Vázquez-Luis<sup>1\*</sup>, J. Borg<sup>2</sup>, E. Álvarez<sup>3</sup> and S. Deudero<sup>1</sup>

<sup>1</sup> Centro Oceanográfico de Baleares - maite.vazquez@ba.iao.es

<sup>2</sup> Department of Biology, Faculty of Science, University of Malta

<sup>3</sup> Govern de les Illes Balears. Direcció General de Medi Rural i Marí.

## Abstract

The impact of boat anchoring on the Mediterranean endemic bivalve *Pinna nobilis* Linnaeus (1758) was assessed experimentally in the field by installing non-biological mimic units of the bivalve in the islands of Mallorca and Malta. In each of these two Mediterranean localities, two study areas having different levels of boat anchoring activities: 'control' (no anchoring allowed) and 'impacted' (anchoring allowed), were used for the field experiment. A significant number of *P. nobilis* mimic bivalves were affected by boat anchoring in the impacted areas; the impact was 3 times higher in impacted areas compared to control areas. Boat anchoring also had an adverse impact on *Posidonia oceanica* meadows, since seagrass cover was lower in the impacted areas.

**Keywords:** Bivalves, Endemism, Balearic Islands, Malta Trough, Coastal management

**1. Introduction** Anchoring by recreational boats causes an adverse impact on vulnerable and protected habitats and species. *Posidonia oceanica* seagrass meadows are the main habitat of the endemic fan mussel *Pinna nobilis*, the largest Mediterranean bivalve. Both *P. oceanica* and *P. nobilis* are under threat due to anthropogenic activities, especially in shallow coastal waters. Boating activities are increasing in Mediterranean coastal areas, especially during the summer months. Since boat anchoring causes physical damage to seagrass habitat [1], the activity can also affect the associated *P. nobilis* populations, given the large size of the bivalve. However, such direct physical adverse impact has never been assessed. Therefore, the aim of the present study was to evaluate the impact of boat anchoring on *P. nobilis* by using a field experimental approach in two Mediterranean islands that are support a high level of boating activities.

**2. Materials and methods** Deployment of non-biological mimic units of *P. nobilis* in *Posidonia oceanica* meadows within the 3 m to 10 m depth range was carried out during the period July to October 2012 using SCUBA diving. The experiment was conducted in two areas having different levels of boat anchoring activities: 'control' (no anchoring allowed) and 'impacted' (anchoring allowed), in the islands of Mallorca and Malta. The experimental design comprised 3 factors: 'protection' (fixed, with two levels, impacted and control), 'locality' (random and nested in protection, with 5 levels nested in control and 7 levels nested in impacted), and 'site' (random and nested within protection and locality, with three levels). For each treatment, 5 mimic bivalve units were deployed on the seabed within *P. oceanica* meadows. Statistical analysis was performed using PERMANOVA. Additionally, data on *P. oceanica* meadow cover and on the natural population of *P. nobilis*, were recorded for Mallorca.

**3. Results** The results indicated a significant impact of boat anchoring on the *Pinna nobilis* mimic units (Fig. 1, p value = 0.031). Of the affected mimic units, 12.09% were found leaning at an angle, 35.16% were found lying horizontally on the seabed and 52.75% were not found. The adverse impact of boat anchoring is also reflected on the *P. oceanica* habitat, since seagrass cover was significantly higher in the control areas (p-value: 0.001) in Mallorca.

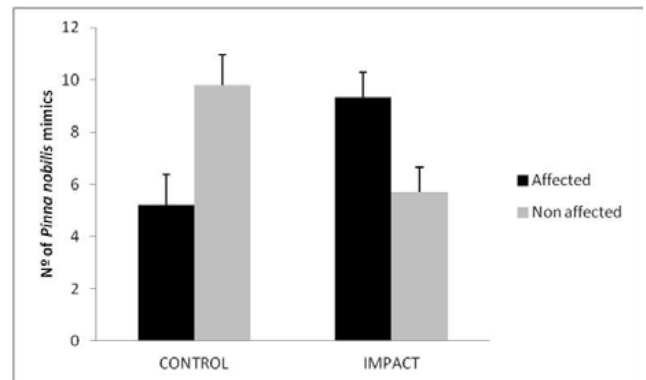


Fig. 1. Overall mean percentage affected and non affected ( $\pm$  standard error) *Pinna nobilis* mimic units.

**4. Discussion** The present results clearly indicate that *P. nobilis* mimic units were significantly affected by boat anchoring in impacted areas. Our findings highlight the importance of regulating coastal recreational activities [2] by adopting appropriate measures, for example, controlling the number of boats that enter areas where anchoring is allowed without any limitations [3]. A possible solution to minimize the impact of boat anchoring is to install mooring buoys and having environmental education programs in place to inform boat owners of the adverse effects of anchoring on *P. oceanica* and their associated biota. Such measures are important for protecting natural marine resources and improving future planning and decision making, thereby ensuring effective coastal management.

## References

- 1 - Francour P., Ganteaume A., Poulain M., 1999. Effects of boat anchoring in *Posidonia oceanica* seagrass beds in the Port-Cros National Park (north-western Mediterranean Sea). *Aquatic Conservation Marine and Freshwater Ecosystems*, 9: 391–400.
- 2 - Hendriks I., Tenan, S., Tavecchia G., Marbà N., Jordà G., Deudero S., Álvarez E., Duarte C., 2012. Boat anchoring impacts coastal populations of the pen shell, the largest bivalve in the Mediterranean. *Biological Conservation*, 160: 105–113.
- 3 - Balaguer P., Diedrich A., Sardà R., Fuster M., Cañellas B., Tintoré J., 2011. Spatial analysis of recreational boating as a first key step for marine spatial planning in Mallorca (Balearic Islands, Spain). *Ocean and Coastal Management*, 54: 241–249.